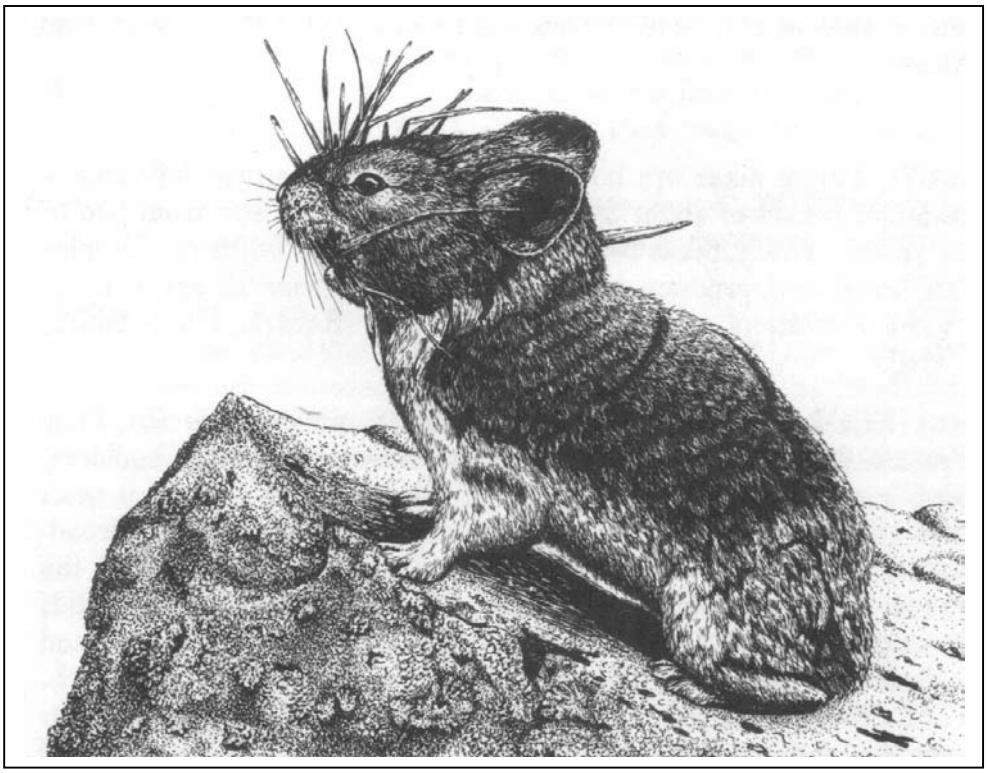
# Mammal Inventory of Alaska's National Parks and Preserves

## *Wrangell-St. Elias National Park and Preserve*

### Annual Report 2001-2002

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## *Executive Summary*

*In July and August of 2001 and August of 2002, field crews from the Beringian Coevolution Project (BCP) at Idaho State University (ISU) sampled the small mammal fauna at 14 base locations in Wrangell-St. Elias National Park and Preserve (WRST) for a total of 242 person-days (over 9812 trap nights) of collecting effort.*

*Other primary institutions participating in the inventory included the University of Alaska Museum (UAM), USDA National Parasite Lab, University of New Mexico, University of Saskatchewan, Institute of Biological Problems of the North-Magadan, Russia, and The Finnish Forest Research Institute (Vantaa Research Centre).*

*The specific products of this study include a large collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). A total of 983 small mammal specimens comprising 17 species was archived from the 14 general localities.*

*Across all localities, three murid rodents (northern red-backed vole, meadow vole, and tundra vole) and a shrew (montane shrew) were the most frequently sampled species (309, 204, 191, and 91 specimens, respectively), comprising 88% of all specimens collected.*

*The discovery of the tiny shrew (*Sorex yukonicus*) at Carden Hills and Braye Lakes constitutes a new species for WRST and significantly expands the known range of the species by over 300 kilometers from the nearest locality in central Alaska. It is likely that this species extends into Canada, although it has not yet been documented there. This study also provides the first documentation of the water shrew, tundra shrew, and singing vole in WRST, and contributes new locality information on several other species, including hoary marmot, meadow vole, long-tailed vole, brown lemming, and northern bog lemming.*

*The findings from this inventory, when combined with specimen information gathered from a review of holdings in other major collections, bring the total number of documented small mammal species in WRST to 21 of 26 potential species, or 81% coverage. Additional effort should focus on documenting ermine, least weasel, northern flying squirrel, meadow jumping mouse, taiga vole, and muskrat, as well as providing more detailed documentation of several other species now known by very few specimens.*

## Introduction

This report details an inventory of the small mammals of the Wrangell-St. Elias National Park and Preserve (WRST) in July and August of 2001 and August 2002. The Beringian Coevolution Project at Idaho State University (ISU) worked collaboratively with the Inventory and Monitoring Program of the National Park Service, Alaska, and the University of Alaska Museum (UAM) to conduct an inventory at selected sites throughout the Park to document the occurrence, relative abundance, and general habitat affinities of the small mammal fauna. This effort is beginning to provide a large series and variety of permanently preserved materials and associated data sets for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes. Because the fauna of Alaska is the least studied of the continent, these NPS inventories are an important contribution to our understanding of mammalian diversity. The mammal fauna of the Wrangel-St. Elias Park and Preserve is typical of the Nearctic realm, although heavily influenced by the Beringian refugium which was at the crossroads between North America and Asia. Hence, this fauna reflects extensive interchange with Asian elements as recently as 12,000 years ago. Several groups of mammals are common in both the Old and New World northern latitudes and these occur on National Park Service lands in Alaska (e.g., among rodents: ground squirrels (*Spermophilus*), marmots (*Marmota*), and voles (*Microtus*)). The dynamic geologic and climatic history that this region has experienced provides an important context for understanding the fauna of WRST which is comprised of relatively recent immigrant species from diverse regions. Well documented species distributions will also provide a context for interpreting of the magnitude of the impact from predicted climate change at these northern latitudes (Parmesan and Yohe 2003, Root et al. 2003).

The documentation of species' occurrence in WRST was complemented by a review of specimen holdings at the University of Alaska Museum and other major collections, including the U.S. National Museum (USNM) and the American Museum of Natural History (AMNH). Scientific and common names of mammals used in this report follow Wilson and Reeder (1993) and Wilson and Cole (2000), respectively. Vegetation classification generally follows Viereck et al. (1992).

## Methods and Materials

In field seasons 2001 and 2002, BCP field crews sampled from 14 base locations (Tables 1a, 1b) for a total of 242 person-days (over 9812 trap nights) of collecting effort. These localities were scattered throughout the Park (Figure 1) from the Chugach Mountains northward in a variety of elevations and habitats. Helicopter and fixed-wing air support in 2001 was provided by the National Park Service. The McCarthy and Nabesna roads were survey by UAM vehicle in 2002. Voucher specimens were deposited in the University of Alaska Museum.

### Field Locations

2001:

**Chisana** (62°03'N, 142°02'W; Nabesna Quad). 17 – 20 July 2001. Both crews used Park Service facilities near the village of Chisana to sample a diversity of habitats on sites averaging 1036 m in elevation.

**Rock Lake** (61°47'N, 141°12'W; McCarthy Quad). 20 – 24 July 2001. Crew A chose a high site near the SE side of Rock Lake to set up base camp. Traplines were established in a variety of habitats from spruce woodland to alpine tundra and scree slopes at elevations ranging from 1274 m to 1407 m.

**Carden Hills** (62°18'N, 141°10'W; Nabesna Quad). 20 – 24 July 2001. Crew A located camp just above treeline at 1299 m elevation near the NE end of these isolated hills. Sampling encompassed a variety of taiga, tundra and rocky habitats.

**Solo Mountain** (61°50'N, 141°50'W; McCarthy Quad). 24 – 28 July 2001. Crew B used the Park Service cabin located at the base of Solo Mountain to set traplines in a variety of alpine scrub and herbaceous habitats ranging from 1489 to 1796 m in elevation.

**Braye Lakes** (62°01'N, 141°07'W; Nabesna Quad). 24 – 28 July 2001. Crew A's base camp was situated at the head of the upper lake of the Braye Lakes complex. Collecting efforts extended from 1130 to 1500 m in a variety of herbaceous, scrub, and woodland habitats.

**Pocket Creek** (61°03.5'N, 143°21.8'W; McCarthy Quad). 29 July – 2 August 2001. Crew B sampled a diversity of alpine habitats between 1223-1307 m from base camp near a small, clear lake along Pocket Creek where a pack trail runs southwest along a tributary of the creek over a pass to Golconda Creek.

**Rex Creek** (61°18'N, 142°31'W; McCarthy Quad). 29 July – 2 August 2001. Crew A located base camp at 1475 m in a glacial cirque overlooking the upper valley of Rex Creek near its confluence with Sheep Gulch.

**Harry's Gulch** (61°03.9'N, 143°54.2'W; McCarthy Quad). 2 – 6 August 2001. Base camp for Crew B was at a high, dry site in the middle drainage of Harry's Gulch. Traplines sampled alpine habitats on sites ranging from 938 m to 1064 m in elevation.

**Tana Lake** (61°00'N, 142°45'W; McCarthy Quad). 2 – 6 August 2001. Crew A placed base camp near the outlet of an unnamed alpine lake (designated "Tana Lake" in this study) located approximately 1200 m in elevation and 2-3 km southwest of the Tana River Landing Strip.

**Summit Lake** (61°19'N, 144°14'W; Valdez Quad). 6 – 10 August 2001. Crew B situated base camp near a small group of lakes located above and to the SW of Summit Lake at 1015 m elevation. Sampled were a diversity of herbaceous and scrub habitats ranging from 940 m to 1045 m in elevation.

**Goat Creek** (60°59'N, 142°02'W; Bering Glacier Quad). 6 – 10 August 2001. This alpine site of Crew A was based at 1409 m elevation in the mountains east of Goat Creek and south of Chitina River.

2002:

**Chokosna Lake** (61° 27'N, 143° 47'W; McCarthy Quad). 3-5 August 2002. From a roadside camp at the Gilahina River bridge, we set most of our traplines near Chokosna Lake and its adjacent wetlands located 3 kilometers west of Chokosna River bridge, milepost 27 McCarthy Road.

**Ruby Lake** (61° 21' 56" N, 143° 26'33" W; McCarthy Quad). 5-6 August 2002. An open boggy areas surrounding this small, roadside lake (also called Ruth Lake) at about Milepost 42 McCarthy Road was sampled with pitfall traplines for 1 night.

**Twin Lakes** (62° 32'N, 143° 15'W; Nabesna Quad). 6-9 August 2002. Located in the upper reaches of Jack Creek drainage, Nabesna River watershed, the Twin Lakes rest area near Milepost 28, Nabesna Road, was used to base a sampling of riparian and upland habitats in the area.

## Field Studies

Between 17 July and 6 August 2001, two field crews of 4 people each sampled 11 general localities at higher elevations in WRST. In 2002, a single crew of 6 people sampled 3 lowland localities along the McCarthy and Nabesna roads from 3 to 9 August. Crew members in 2001 were Eric Hoberg, Michael Lucid, Dana Lucid, and Ben Fogel (**Crew A**); and Sue Kutz, Albina Tsevtkova, Aren Eddingsass, and Michael McCain (**Crew B**). In 2002, field personnel included Stephen MacDonald, Eric Waltari, Kayce Bell, Jeff Good, Lourdes Barrelli, and Darren Zibell, a high school student-in-training from the village of Noorvik in northwestern Alaska.

Our overall collecting strategy was designed to maximize the number and diversity of samples by using a variety of methods in available habitats. While particular effort was made to sample rare or undocumented small mammals, the sampling methods used also allowed us to evaluate the occurrence and relative abundance of the more common species.

Diversity of captured specimens was maximized by utilizing a variety of trap types, including snap traps (Museum Specials, rat traps) and live traps (44 oz. plastic drinking cups buried as pitfall traps, Sherman traps). Larger species, such as the arctic ground squirrel, were sampled with shotgun.

Traplines for shrews and voles were set in the range of available habitats and ecotones in each study location. Traplines typically consisted of 20 or more trap stations per line, with stations spaced 8-10 m apart. At each station, 2 snap traps or 1 snap trap and 1 pitfall trap were typically set within 2 m of each station point. The snap traps were baited with a mixture of rolled oats and peanut butter; pitfall traps were buried flush with the ground and left unbaited. Traps were usually checked twice daily. Productive lines were usually kept in operation for 2 or more nights.

## Specimen Processing

Each animal sampled was preserved as a scientific specimen in the form of a skeletal preparation or as a whole bodied fluid (ETOH) preparation. A small number of dried study skins were also prepared. Each crew carried a tank of liquid nitrogen in the field to preserve tissues (heart, liver, kidney, spleen, and lung) and embryos. These frozen specimens were transferred to ultra-low temperature freezers at UAM and are archived at -70° C. We preserved ectoparasites, endoparasites and feces samples from many of the mammals collected. These exceptional data sets will be used to address epidemiological, coevolutionary, taxonomic, and biogeographic questions. Intestinal tracts from shrews were also preserved. Field protocols (Appendix) allowed us to rigorously document and preserve specimens.

All mammal specimens from this study have been accessioned into the mammal collection at UAM and are in various stages of curation. The samples of endoparasite are now at the US National Parasite Collection in Beltsville, MD and the Vantaa Research Centre in Vantaa, Finland. All ectoparasites are currently at Idaho State University and feces samples (for Coccidia) are under study at the University of New Mexico. Spleen and blood samples have been sent to the Harvard School of Public Health, and lung samples will be examined by colleagues in Finland.

## Results and Discussion

### Inventory Results

The specific products of this inventory include a large collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). A total of 983 small mammal specimens (excluding embryos) comprising 17 species was archived from 14 general localities sampled in 2001 and 2002 (Tables 1a, 1b).

Three murid rodents (northern red-backed vole, meadow vole, and tundra vole) and a shrew (montane shrew) were the most frequently sampled species (309, 204, 191, and 91 specimens, respectively; Figures 2a, 2b), comprising about 80% of all specimens collected. The number of small mammals sampled in each general locality is shown in Tables 1a and 1b.

This study, when combined with specimen information gathered from our review of holdings in other major collections, increased the total number of documented small mammal species in WRST to 21 (out of a probable 26), or 81% coverage (Table 2).

The discovery of the tiny shrew (*Sorex yukonicus*) at Carden Hills and Braye Lakes constitutes a new species for WRST. This study also provides the first documentation of the water shrew (*Sorex palustris*), tundra shrew (*S. tundrensis*), and singing vole (*Microtus miurus*) in WRST, and provides new information on several other species, including hoary marmot (*Marmota caligata*), meadow vole (*Microtus pennsylvanicus*), long-tailed vole (*M. longicaudus*), brown lemming (*Lemmus trimucronatus*), and northern bog lemming (*Synaptomys borealis*).

### Species Accounts

The following accounts summarize information on 44 land mammal species known or suspected to occur in WRST (Table 2). An asterisk (*) indicates that the species was observed but not collected in this study or has been previously documented from other investigations. Species that have been reported in WRST, but have not been documented with a voucher specimen are marked with a dagger (†). Several of the species are known from very few records and should be further studied (‡). Detailed data on all specimens will be available in the UAM database and accessible on its website (http://arctos.museum.uaf.edu:8080/uam_db/).

Order **INSECTIVORA**—Shrews

Family **Soricidae**

*Sorex cinereus*, cinereus shrew

We sampled a total of 67 cinereus shrews at 10 of 14 general localities, with the largest series of specimens coming from Chokosna Lake and Braye Lakes (Table 1a). Cinereus shrews occurred in all major vegetation types, but were most numerous in moist open habitats at lower elevations.

*‡*Sorex hoyi*, pygmy shrew

We did not collect any pygmy shrews during our inventory. However, a single specimen of this species was previously taken near Milepost 18 Nabesna Road by R. L. Rausch (1967).

*Sorex monticolus*, montane shrew

We captured more montane shrews than any other species of shrew. All but 1 of the 91 animals sampled were taken at higher elevations (> X meters) in the Park.

‡*Sorex palustris*, water shrew

The capture of a water shrew near Twin Lakes, Nabesna watershed, constitutes a new species to WRST and is an important new record for the region (Figure 5). The closest known occurrence of this species prior to this study is from west of the Park in the headwaters of the Gulkana River (MacDonald and Elliot 1984). The Twin Lakes water shrew was captured in a pitfall trap set close to a clear stream that flowed through grassy thickets of willows in an old defunct beaver pond near one of the lakes.

‡*Sorex tundrensis*, tundra shrew

A single tundra shrew captured at Carden Hills is the first and only record of this species in WRST and the Copper River watershed.

‡*Sorex yukonicus*, tiny shrew

The tiny shrew is a new species to WRST and the capture of a single animal at Carden Hills and another at Braye Lakes constitute major range extensions of the species (Figure 6). The Carden Hills specimen was taken at 1299 m elevation in a mesic grassy meadow, whereas the Braye Lakes animal was found in spruce woodland at 1139 m elevation.

Prior to 2001, only 12 specimens of *S. yukonicus* were known to science (Dokuchaev 1997; pers. com. 2001). Inventories in Alaska, especially in 2001 and 2002, increased the number of specimens to 30 and includes new records from 5 other National Parks and Preserves (YUCH—6 specimens in 2001; DENA—1 specimen in 2002; GAAR—1 specimen in 2002; BELA—4 specimens in 2001; and, LACL—1 captured in 1999 and discovered in a Moscow museum in 2001 by Russian colleague and inventory participant, Dr. N. Dokuchaev).

## Order **CHIROPTERA**—Bats

### Family **Vespertilionidae**

*‡*Myotis lucifugus*, little brown bat

A *Myotis* bat was seen flying low over spruce forest and road right-of-way near Ruby Lake, McCarthy Road just before dark on 5 August 2002. A local resident reported occasionally seeing bats in the area, most frequently near the town of Chitna and in some of the buildings there. Parker et al. (1997) reported a single specimen of *M. lucifugus* from Chitistone River cave in addition to several sightings that likely were this species near Glenallen and Mentasta Lake.

## Order **CARNIVORA**—Carnivores

### Family **Canidae**

**Canis latrans*, coyote

No coyotes or their sign were observed during our study. A trapper from 28 Mile Nabesna Road said coyotes were present in the area and may have become more numerous in recent years. Laing and Anderson (1929) secured a single coyote specimen from the upper Chitina River valley. UAM has specimens from the Sanford and Gakona rivers.

Coyotes are said to have entered Alaska in the early 1900s (Rearden 1981) and reached peak numbers about 1940 (Dufresne 1946). According to Laing and Anderson (1929), residents of McCarthy did not see coyotes in their area until about 1915. No recent study of coyote distribution or abundance in this region of Alaska has been completed.

**Canis lupus*, wolf

Sign of this wide-ranging species was seen at Braye Lakes and Chisana.

*****_Vulpes vulpes_, red fox

We did not encounter any red foxes during our study. ADFG (1978) considered them common throughout the region, with their numbers influenced mainly by food availability.

Family **Felidae**

*****_Lynx canadensis_, Canada lynx

Lynxes are closely tied to snowshoe hares, which were at a low during this study. Lynx sign was encountered only at Chisana.

†_Puma concolor_, Puma

There have been a number of unsubstantiated reports over the years of puma in east-central Alaska (Nowak 1976, Russell 1978). In 2000, single sightings of this cat were reported from Copper Center and McCarthy (C. Mitchell, pers. com., March 2001). A Native resident on the Nabesna Road reported seeing a mountain lion east of Slana in the late 1960s-early 1970s. These and other reports (including 2 recent specimens from southeastern Alaska) suggest that this species may be expanding its range into the state (MacDonald and Cook 1996, 2000). The puma was apparently a member of the eastern Beringian fauna during the late Pleistocene (Harington 1977, Youngman 1993).

Family **Mustelidae**

*****_Gulo gulo_, wolverine

No sighting or sign of this wide ranging species was recorded during this study.

*****_Lontra canadensis_, northern river otter

UAM has a number of otter specimens from the upper Copper River and its tributaries, including the Nabesna and Chitina rivers. None were seen during the course of our study.

*****_Martes americana_, American marten

Martens, which are common in suitable habitat throughout this region (ADFG 1978), were not recorded during this study.

†_Mustela erminea_, ermine

No ermine were reported during this study. This wide-ranging species has yet to be documented with museum specimens from the Park.

†_Mustela nivalis_, least weasel

This weasel may occur in WRST but its presence there needs verification.

*****_Mustela vison_, American mink

Mink are present along the major waterways of the region, but no specimens have been preserved to documented their occurrence in the Park.

Family **Ursidae**

*****_Ursus americanus_, American black bear

A single black bear was observed at lower elevation near Harry's Gulch in 2001, and single adult and a female with a small cub were seen at McCarthy in 2002.

*****_Ursus arctos_, brown bear

Individual brown bears were encountered only at Harry's Gulch and their sign noted at Braye Lakes, Rex Creek, Chisana, Rock Lake, and Pocket Creek.

Order **ARTIODACTYLA**—Ungulates

Family **Cervidae**

*****_Alces alces_, moose

Our field crews encountered moose and/or their sign at Chisana, Braye Lakes, Rock Lake, Pocket Creek, and at several locations along the McCarthy and Nabesna roads.

†_Odocoileus hemionus_, mule (Sitka black-tailed) deer

As early as 1972, but especially between 1980 and 1984, at least 19 sightings of deer, presumably *O. h. sitkensis*, the small, coastal form introduced to Prince William Sound in the early decades of the past century, were reported in the Copper River Basin, including 1 report from along the McCarthy Road in WRST (Roberson 1986). The subsequent lack of sightings in the Basin suggest these may have been temporary dispersals and not permanent range extensions.

*****_Rangifer tarandus_, caribou

New and old sign of caribou was seen in the Rock Lake area.

Family **Bovidae**

*****_Bison bison_, American bison

The Copper River bison herd originated from a transplant of 17 animals near Slana from the Delta herd in 1950. The small Chitina River herd originated either as a result of egress from the Copper River herd or from a transplant effort of questionable success in 1962 from Delta animals to May Creek (ADFG 1973). Saltmarch (1978) encountered about 40 bison on the Dadina River bar about 16 km downriver from the glacier snout.

*****_Oreamnos americanus_, mountain goat

Mountain goats were sighted in the vicinity of Pocket Creek (at least 2 adults and 1 young) and Tana Lake (3 adults, 1 young). The northern limit of this species' range extends into the southern drainages of the Wrangell Mountains.

*****_Ovis dalli_, Dall's sheep

Dall's sheep were encountered in the vicinity of Rex Creek, Solo Mountain, and Goat Creek.

Order **RODENTIA**—Rodents

Family **Sciuridae**

†_Glaucomys sabrinus_, northern flying squirrel

The occurrence of flying squirrels in WRST is inadequately documented. In 2002, we were informed by a local resident that trappers along the McCarthy Road occasional capture flying squirrels in their marten sets. A trapper from near Twin Lakes, Nabesna Road, said flying squirrels occurred mostly north of the Mentasta Mountains.

*****‡_Marmota caligata_, hoary marmot

We recorded marmots at Rock Lake, Solo Mountain, Pocket Creek (1 collected, many seen or heard), Harry's Gulch (only 1 seen), Tana Lake, and Summit Lake (several heard). The presence of this species in WRST is not reported by Laing and Anderson (1929), Murray and Murray (1969), Saltmarch (1978), or R. L. Rausch (pers. com. in Saltmarch 1978). There are 5 preserved specimens from Francis Creek, 8 km N of Ptarmigan Lake, in the American Museum of Natural History (*see also* Hoffmann et al. 1979).

*****_Spermophilus parryii_, arctic ground squirrel

We found arctic ground squirrels widely distributed and often abundant throughout the higher elevations of WRST (including Cardin Hills). Samples were taken at most localities, and there is a small series of ground squirrels in the AMNH collected in 1940 from Francis Creek. Unoccupied burrows of ground squirrels were noted around Chisana. According to a local resident, "parka" squirrels were once abundant in the area.

*****_Tamiasciurus hudsonicus_, red squirrel

This species is widely distributed throughout the forested areas of WRST. Red squirrels were sampled at Chisana and along the McCarthy Road at Gilahina River and Ruby Lake. Individuals were seen or heard at McCarthy and at Milepost 28 Nabesna Road. The AMNH has 6 red squirrel specimens collected in 1940 from the upper White River.

Family **Castoridae**

*****_Castor canadensis_, American beaver

We saw beaver or their sign in a number of ponds and lakes along the McCarthy and Nabesna roads. Laing and Anderson (1929) reported beaver in the upper Chitina River. According to ADFG (1978), beaver are common to abundant along the Copper River.

Family **Dipodidae**

†_Zapus hudsonius_, meadow jumping mouse

No jumping mice were collected and their presence in WRST remains hypothetical. Jumping mice are generally found in shrubby thickets and meadows bordering streams, ponds, and other openings, including old fields and recovering disturbed sites.

Family **Muridae**

_Clethrionomys rutilus_, northern red-backed vole

The red-backed vole is one of the dominant mammal species of the Park, occurring at nearly all localities sampled and in all major habitats. This vole was abundant in lowland forests and scrub in 2002.

‡_Lemmus trimucronatus_, brown lemming

Our captures of brown lemming were limited to localities north of the Wrangell Mountains. Only 2 brown lemmings were captured in 2001: 1 in mesic meadow at Chisana, and another at water's edge at Braye Lakes. Seven more lemmings, all from Twin Lakes, Nabesna Road, were added in 2002.

Dr. Vadim Fedorov, UAM, has now sequenced 915 base pairs of mtDNA cytochrome *b* of the *Lemmus* specimens collected in 2001 (Fedorov et al. 2003). His findings suggest that two divergent (6%) phylogeographic groups come in contact within the boundaries of WRST. The lemming from Chisana had a Beringian (i.e., Alaska, eastern Siberia) haplotype while the animal from Braye Lakes had a haplotype of a more Eastern group (Canadian arctic east of the Mackenzie Delta and, interestingly, an animal from the upper Susitna River).

‡_Microtus longicaudus_, long-tailed vole

A small number of long-tailed voles (N=12) was collected at 3 localities: Braye Lakes, Carden Hills, and Summit Lake. They were usually found in areas with dense grass and numerous rocks at higher elevations. Previous studies have documented this species' occurrence in the upper Chitna Valley (Laing and Anderson 1929), Chisana (UAM), and on Fireweed Mountain, west of McCarthy (UAM).

‡*Microtus miurus*, singing vole

The only singing voles encountered during this inventory were 3 individuals captured at Chisana. These are the first confirmed records of the species in WRST. Singing voles are found in many of the mountainous areas of Alaska (including the Talkeetna Mountains) and southern Yukon Territory, so their apparent absence from the Wrangell and Chugach Mountains is puzzling and in need for further study.

*Microtus oeconomus*, tundra vole

We collected a total of 191 tundra voles at 10 of the 14 localities surveyed. They were particularly abundant in the grassy forest openings and meadows at Twin Lakes in 2002.

*Microtus pennsylvanicus*, meadow vole

Meadow voles were the second most frequently captured species, with all but 1 specimen (an individual captured at the edge of an alpine lake along Pocket Creek in 2001) sampled in abundance in grassy riparian habitats at lower elevations. We found them particularly numerous in marshy lake-edge habitats along the McCarthy Road in 2002.

†*Microtus xanthognathus*, taiga vole

This vole was not encountered during our study; however, a recent collection (UAM) of taiga voles from Wellesley Lakes, Tetlin National Wildlife Refuge, close to the northeastern most boundary of WRST, suggests their probable occurrence within the Preserve. Further sampling of older burn areas in the vicinities of Stevens and Carden lakes should add this species to WRST's documented list.

*****Ondatra zibethicus*, muskrat

Several muskrats were seen swimming in a small pond near Twin Lakes, Nabesna Road. Muskrat sign was also noted at Chokosna Lake, McCarthy Road. We were informed by a Nabesna area trapper that muskrat populations have been low in recent years.

*Synaptomys borealis*, northern bog lemming

A small number (N=11) of northern bog lemmings was collected at the higher elevations of WRST in 2001. We found them relatively numerous (N=41) in wetland habitats at lower elevations in 2002.

Family **Erethizontidae**

*****Erethizon dorsatum*, North American porcupine

No porcupines were encountered, although this species has been reported as common throughout the region, occurring from below treeline to the upper limit of brush (Saltmarch 1978). Four specimens from the upper Chitina River area were preserved by Laing and Anderson (1929).

## Order **LAGOMORPHA**—Pikas and Hares

Family **Ochotonidae**

*Ochotona collaris*, collared pika

Pikas were common in rock piles and talus slopes at higher elevations. Samples were taken or their presence noted at most of the alpine localities visited in 2001.

Family **Leporidae**

***Lepus americanus***, snowshoe hare

Scat of snowshoes hares was noted at Chisana and an individual was seen near Chokosna Lake, McCarthy road. A local resident told of hares being abundant in the region up through 2000. Laing and Anderson (1929) reported on a major winter die-off of hares in the Copper, Nizina, and lower Chitina river valleys, and preserved 7 specimens from the upper Chitina River area.

## Habitat Affinities

Habitats of small mammals are often defined by their association with particular plants (Hoffmeister 1986). Under the influences of the topography, soils, climate conditions, and other ecological factors, plants may be placed into distinct groups referred to as vegetative communities, associations, or types. A mammal species usually is associated with particular plant communities (at various macro- to micro-scales). Some species are restricted to few communities, others are found in many. The degree of a species' dominance in a particular vegetative community and its range across various communities often is related to varying population levels. Populations of small mammals of high latitudes often fluctuate dramatically from year to year and season to season. These shifts in abundance, along with dynamic interspecific interaction (particularly among congeneric species) suggest that long-term studies of small mammal communities will be required to carefully assess the particular affinities of each species.

Besides vegetation, other features and factors may influence a species' distribution, including topography, soil types, snow cover, availability of food or pathogens, and/or the presence of other important features such as water bodies, rocks, and ground litter. The unique biogeographic and evolutionary history of each species also influences its current distribution. Because Alaska's habitats have changed markedly since the last glaciation, the current distribution of nearly all species must be viewed within the dynamic geologic history of these high latitudes.

Our preliminary work in this vast park and preserve indicates that shrews, voles and lemmings were unevenly distributed over the range of vegetation types and elevations sampled (Table 3). Patterns of habitat occupancy indicated that red-backed voles tolerated a broad range of vegetation types, but were most abundant in forest and woodland habitats (Figure 3b). The local distribution of this common species may be closely tied to the presence of overhead cover, especially woody plant cover. Tall tussocks, rocks, and thickets of low shrubs may serve as overhead protection in non-forested habitats.

The habitat requirements of shrews are primarily related to invertebrate abundance and physical conditions such as temperature and moisture (Nagorsen 1996). Most shrews seem to require moist sites with adequate ground cover. Shrew populations appeared especially low during this study. Montane shrews were generally confined to herbaceous- and scrub-tundra habitats in the mountains, whereas the usually abundant cinereus shrew occurred primarily in open scrub and moist meadows at lower elevations. The water shrew may have the most limited habitat distribution of any of the WRST's shrew species, as it is restricted to riparian habitats with dense ground cover along clear streams, lakes, beaver ponds, and marshes at various elevations. Too little is known yet about the habitat requirements of the tiny shrew. The 2 captured in this study were from spruce woodland and mesic meadow near the edge of treeline.

The two most abundant *Microtus* voles displayed differing patterns of habitat occupancy. Meadow voles (along with most bog and brown lemmings) were generally restricted to wet meadow and open riparian scrub habitats at lower elevations, while tundra voles were more widespread, occurring in grassy forest openings at low elevations to moist sedge meadow and scrubby drainages in the mountains. The limited captures of long-tailed voles suggest a preference to drier grassy sites in rocky situations at higher elevations in WRST.

In the mountains, arctic ground squirrels occurred in tundra, meadow, streambank, and lakeshore habitats with loose, friable soils and adequate supplies of low, early successional vegetation. Hoary marmots preferred rocky tundra habitats on the precipitous sides of canyons and valleys, while another alpine creature, the pika, was found in rock slides and talus slopes near meadows and patches of vegetation.

Below timberline, the red squirrel was a characteristic inhabitant of needleleaf forest, particularly white spruce forest, but was quite versatile, occurring in mixed broadleaf forest. The specific habitat requirements of the flying squirrel are little known, but it is generally assumed that this species is closely associated with mature and old growth forests. Snowshoe hares inhabit forests, shrubby woodlands and riparian shrub thickets.

Overall, small mammals were most diverse (species richness) in herbaceous habitats (at various elevations) and most abundant in scrub and forest habitats at the lower elevations (Figure 4).

## Summary and Significance

The small mammal fauna of WRST remains one of the least known in the state. The immensity, ruggedness, and remoteness of this multi-region park have long hampered concerted efforts to document its potentially rich and informative fauna. The region plays a central role in understanding the biogeography of the Pacific Northwest as it is a suture zone between Beringian and southern faunas. Specimen based inventories will play a central role in teasing apart the dynamic history (and future) of the region. This inventory, conducted in 2001 and 2002, is a start at rectifying this situation. Approximately 81% of the small mammals believed to occur in WRST are now documented with at least 1 specimen, but still x % are known by fewer than 10 specimens. This crude level of documentation is not sufficient to address the critical questions related to conservation and management that will persist and grow in importance in Alaska's great reserves.

Our initial findings confirm a rich assemblage of mammals; a fauna that contains several species newly documented for WRST (e.g., tundra shrew, northern water shrew, tiny shrew, and singing vole). Several species have thus far been found only north of the Wrangell Mountains, primarily in the Yukon watershed including water shrew, tundra shrew, tiny shrew, pygmy shrew, brown lemming, and singing vole. Recent samples of taiga vole (*Microtus xanthognathus*) in Tetlin National Wildlife Refuge near the WRST boundary suggest the probable occurrence of this species in WRST.

The more broad-ranging species (south into the Chugach Mountains) include cinereus shrew, montane shrew, northern red-backed vole, long-tailed vole, tundra vole, meadow vole, northern bog lemming, hoary marmot, arctic ground squirrel, red squirrel, snowshoe hare, and collared pika. Other species expected but not yet documented are meadow jumping mouse, taiga vole, ermine, least weasel, and northern flying squirrel.

Of the Park's 40-some species of land mammals (Table 2), none is endemic to the region. WRST mammals with holarctic distributions (Eurasia and North America) include wolf, red fox, wolverine, ermine, brown bear, moose, caribou, arctic ground squirrel, northern red-backed vole, brown lemming, and tundra vole. The remaining 30 or so species are exclusively nearctic (North American).

Patterns of general habitat occupancy among 16 species sampled in WRST were comparable to those reported in other studies in Alaska and neighboring Yukon Territory ( e.g., Buckley and Libby 1957, Pruitt 1968, Banfield 1974, Krebs and Wingate 1976, West 1979, MacDonald 1980, Buskirk and MacDonald 1984). Five species—2 insectivores (montane shrew, cinereus shrew), a generalized fruit-seed-leaf feeder (northern red-backed vole), and 2 graminoid grazers (meadow

vole, tundra vole)—dominated the small mammal community of WRST, accounting for 88% of all trapline captures. Arctic ground squirrels and collared pikas were prominent members of the Park's alpine community.

Our discovery of the tiny shrew, *Sorex yukonicus*, perhaps the rarest and poorest known mammal in North America, was a pleasant surprise. The 2 tiny shrews sampled at the northeastern corner of the Park significantly expands the known range of the species (Figure 6) and together with samples collected in other NPS Units in Alaska in 2001 and 2002, nearly triples the number of specimens known to science.

The most significant and valuable product of this inventory is the large collection of well-documented and diverse preparations of scientific specimens.

Why specimens? As elucidated by Reynolds et al. (1996), voucher specimens and corresponding data assembled during field surveys of mammals are critical for accurate identification of the animals studied and for verification of the data gathered and reported as resulting from the investigation. Voucher specimens are particularly valuable for studies of the smaller species that are difficult to identify (e.g., shrews, *Microtus* voles) and often poorly known (most Alaska small mammals).

Long after the original inventory is completed, voucher specimens and their associated materials will be used for a wide array of studies such as taxonomic revisions, biogeographic and conservation studies (e.g., Cook and MacDonald 2001), evolutionary studies (Cook et al. 2001), parasitology (e.g., Hoberg et al. 2003), and epidemiology (e.g., Goethert et al. ms).

Voucher specimens also provide critical historical baseline for assessment of change caused by natural or human perturbations. As they represent historical populations, the value of large series of specimens increases through time, particularly as the diversity of many localities is degraded. Solid inventories of federal lands has become increasingly important as these lands often are now used to establish baseline conditions for investigations aimed at documenting anthropogenic influences and other impacts responsible for environmental change. Lessons learned from the *Exxon Valdez* disaster in nearby Prince William Sound suggest that baseline data are critical to interpretation of impacts. With PCR (polymerase chain reaction) and other innovations in the study of DNA, we now can examine and monitor genetic variation in populations of animals that were collected during different time periods; thus providing a more rigorous view of temporal genetic variation and population structure. For example, known contact zones between taxa can now be reanalyzed for temporal stability (but only if specimens from the contact zone were collected at regular intervals). Because of the dynamic geologic history of Alaska and the role that glaciers played in the distribution of organisms, these kinds of studies are essential to documenting and managing biodiversity. Recent concern with POPS combined with rapid technological innovation with regard to our ability to track POPS, further enhances the utility of these specimens in such crucial areas of study such as monitoring environmental quality.

Without the preservation of specimens, inventories such as this one would have extremely limited value (either short-term or long-term). Federal tax dollars used for biodiversity assessments are most efficiently spent if agencies recognize the critical need for vouchers and provide support in both field and museum budgets for their preservation and maintenance (Reynolds et al. 1996).

While the importance of museum specimens should be generally recognized and their preparation considered essential to good science, for many the question remains: Why collect so many specimens?

Some perspectives:

- Alaska mammalogy is still in the early exploration phase. For most species of Alaska mammals, many areas, and WRST in particular, are poorly known and inadequately represented in systematic collections. This point is acutely apparent when recent

phylogeographic studies are reviewed (e.g., Fleming and Cook 2002; Stone at al. 2002; Fedorov et al. 2003).

- Small numbers of specimens will not adequately represent the inherent morphologic, genetic, and parasitic variation that exists within and among populations. Rigorous and statistically defensible scientific studies require large samples of well-preserved (and diverse) materials to account for age, sex, geographic, and/or individual variation. Taxonomic studies based on skull morphology may require undamaged material from 20 or more adult individuals of each sex per locality (i.e., a minimum of 40 adult individuals per population).
- Many of the shrews and small rodents are difficult or impossible to identify except through the careful study of specimens. Close examination of tooth pattern and comparison of body measurements and other characters are necessary to distinguish most of Alaska's shrews. Voles of the genus *Microtus* can also be especially difficult to differentiate.
- Considerable sampling effort is needed to document the rare and uncommon species. In this survey, several thousand pitfall trap nights were required to document two tiny shrews.
- The number of animals removed from a population only has biological significance if it is related to the total number of animals in the population and their rate of replacement (Reynolds et al. 1996). Because Alaska's small mammals are short-lived and prolific, their reproductive potentials is more than sufficient to accommodate low levels of removal through the inefficient sampling methods used in these inventory projects.

## Recommendations for Future Inventory and Monitoring Efforts

1. Inventory studies must be viewed as an ongoing process and NPS must remain committed to continue the efforts begun in these initial inventories. Future **monitoring** efforts should include a sampling regime that regular vouchers diverse preparations (specimens) of representative species. This initial inventory has set the stage for additional collaborative efforts to fully document the small mammal fauna of WRST.
    - As yet unsampled are the Gulf coastal areas of the Park at Icy and Yakutat bays. Based on specimen records from Yakutat and Cape Yakataga, small mammals that may occur in this limited area of the Park are cinereus shrew, montane shrew, little brown bat, haory marmot, red squirrel, meadow jumping mouse, northern red-backed vole, long-tailed vole, tundra vole, porcupine, and ermine. Collared pikas may be one of the only mammals inhabiting the nunatak "islands" that rise above the ice fields of this area.
    - Another important area for continued survey work is in the White River watershed near the Canadian Border. Yukon Territory hosts a number of small mammal species known to reach their distributional limits in close proximity to Alaska and WRST (Youngman 1975). Species of potential occurrence include least chipmunk (*Tamias minimus*), deer mouse (*Peromyscus maniculatus*), bushy-tailed woodrat (*Neotoma cinerea*), and heather vole (*Phenacomys ungava*).
    - More survey work is needed north of the Nutzotin Mountains. An Interior species likely present there is taiga vole. Also possible present is meadow jumping mouse and perhaps woodchuck (*Marmota monax*), a lowland marmot of the Tanana Valley.
    - Developing long-term relations with area fur trappers would be invaluable and is strongly encouraged. Vouchering northern flying squirrel, ermine, and least weasel, along with providing useful series of furbearer specimens, would best be accomplished through such a network.
    - The discovery in 2001 of the tiny shrew, *Sorex yukonicus*, in WRST demonstrates just how much we have yet to learn about Alaska's small mammal fauna. Additional pitfall

trapping in WRST and elsewhere in the state is needed to help determine the full geographic extent of this rare species' distribution, its ecological requirements, and to provide an adequate database of specimens to more precisely assess its taxonomic relationship with other Beringian shrews. Its discovery further illustrates the value of a specimen-based approach to inventory studies. Indeed, the initial detection of this new species to science was made possible only because large series of shrew specimens sampled in surveys from the 1980s were preserved and thus available for later study by specialists.

2. The small mammals of WRST offer a unique opportunity for an array of studies that relate the dynamic glacial history of the region to the origins and evolution of its biota. The apparent restriction of some species (i.e., tundra shrew, pygmy shrew, tiny shrew, singing vole, brown lemming) to the northern portion of the Park, in contrast to others more widely distributed (i.e., cinereus shrew, montane shrew, red-backed vole, meadow vole, long-tailed vole, tundra vole, bog lemming), is suggestive of an ongoing process of colonization into the region from different source areas following the retreat of the last glacial. A recent study by Galbreath (2002) using mitochondrial sequences of the cytochrome *b* gene indicated that colonization of the tundra vole into southcoastal Alaska following the last glacial maximum primarily proceeded via coastal routes from the west, rather than more directly over the mountains from the north, and extended northward into WRST via the Copper River corridor to at least McCarthy.

3. Long-term monitoring on biotic change is best accomplished by preserving materials from populations sampled periodically over time. Specimen-based monitoring of northern small mammal populations has been ongoing in Scandinavia for many decades. Dr. Heikki Henttonen, colleague from Finland and participant in BCP's inventory effort, has been principal investigator of such studies for several decades. We encourage NPS to work closely with individuals such as Dr. Henttonen to develop a rigorous monitoring program throughout Alaska's National Park system.

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Cover drawing of collared pika by S. O. MacDonald from MacDonald and Jones (1987).

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**Table 1a**. Number of small mammal specimens from 11 general localities sampled in the Wrangell-St. Elias NP&P, Alaska, in July-August, 2001.

| | LOCALITY | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIES | Braye Lakes | Carden Hills | Chisana | Goat Creek | Harry's Gulch | Pocket Creek | Rex Creek | Rock Lake | Solo Mtn. | Summit Lake | Tana Lake |
| SHREWS | | | | | | | | | | | |
| *Sorex cinereus* | 12 | 4 | 2 | | 6 | 2 | | 6 | 9 | 7 | |
| *S. monticolus* | 1 | 5 | 1 | 13 | 9 | 20 | 13 | | 8 | 13 | 7 |
| *S. tundrensis* | | 1 | | | | | | | | | |
| *S. yukonicus* | 1 | 1 | | | | | | | | | |
| | | | | | | | | | | | |
| RODENTS | | | | | | | | | | | |
| *Clethrionomys rutilus* | 14 | 2 | 20 | | 6 | | 3 | 60 | 4 | 12 | 13 |
| *Microtus longicaudus* | 2 | 2 | | | | | | | | 8 | |
| *M. oeconomus* | 2 | | | 4 | 2 | 19 | 8 | 4 | 20 | 1 | 5 |
| *M. miurus* | | | 3 | | | | | | | | |
| *M. pennsylvanicus* | | | | | | 1 | | | | | |
| *Lemmus trimucronatus* | 1 | | 1 | | | | | | | | |
| *Synaptomys borealis* | 1 | | | | 2 | 3 | | | | 3 | 2 |
| *Marmota caligata* | | | | | P | 1 | | P | P | P | P |
| *Spermophilus parryii* | 2 | 2 | FP | 6 | 2 | P | | 2 | 4 | 5 | 4 |
| *Tamiasciurus hudsonicus* | | | 1 | | | | | | | | |
| | | | | | | | | | | | |
| PIKA & HARE | | | | | | | | | | | |
| *Lepus americanus* | | | P | | | | | | | | |
| *Ochotona collaris* | 1 | | | | P | 1 | | 6 | 1 | P | P |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| **TOTAL TRAPNIGHTS** | 504 | 1288 | 341 | 709 | 844 | 990 | 897 | 570 | 840 | 743 | 870 |

**Table 1b**. Number of small mammal specimens from 3 general localities sampled in the Wrangell-St. Elias NP&P, Alaska, in August 2002.

| | LOCALITY | | |
|---|---|---|---|
| SPECIES | Gilahina River/ Chokosna Lake | Ruby Lake | Twin Lakes (Nabesna Road) |
| SHREWS | | | |
| *Sorex cinereus* | 18 | | 1 |
| *S. monticolus* | 1 | | |
| *S. palustris* | | | 1 |
| | | | |
| BATS | | | |
| *Myotis sp.* | | P | |
| | | | |
| RODENTS | | | |
| *Clethrionomys rutilus* | 81 | 3 | 91 |
| *Microtus oeconomus* | | | 126 |
| *M. pennsylvanicus* | 166 | 28 | 10 |
| *Lemmus trimucronatus* | | | 7 |
| *Synaptomys borealis* | 21 | 4 | 16 |
| *Tamiasciurus hudsonicus* | 1 | 2 | P |
| | | | |
| PIKA & HARE | | | |
| *Lepus americanus* | P | P | P |
| | | | |
| | | | |
| **TOTAL TRAPNIGHTS** | 638 | 40 | 538 |

**Table 2**. Checklist of the land mammals of *Wrangell-St. Elias National Park and Preserve, Alaska*. Current status: ● = present and substantiated with vouchered specimen, ○ = present or probably present but not substantiated with a voucher specimen, **?** = probable but verifiable information lacking.

**INSECTIVORA - Shrews**
Family **Soricidae**
- ● *Sorex cinereus*, cinereus shrew
- ● *S. hoyi*, pygmy shrew
- ● *S. monticolus*, montane shrew
- ● *S. palustris*, water shrew
- ● *S. tundrensis*, tundra shrew
- ● *S. yukonicus*, tiny shrew

**CHIROPTERA - Bats**
Family **Vespertilionidae**
- ● *Myotis lucifugus*, little brown bat

**CARNIVORA - Carnivores**
Family **Canidae**
- ● *Canis latrans*, coyote
- ● *C. lupus*, wolf
- ○ *Vulpes vulpes*, red fox

Family **Felidae**
- ● *Lynx canadensis*, Canada lynx
- **?** *Puma concolor*, puma

Family **Mustelidae**
- ● *Gulo gulo*, wolverine
- ● *Lontra canadensis*, northern river otter
- ● *Martes americana*, American marten
- ○ *M. erminea*, ermine
- ○ *M. nivalis*, least weasel
- ○ *M. vison*, American mink

Family **Ursidae**
- ● *Ursus americanus*, American black bear
- ● *U. arctos*, brown bear

**ARTIODACTYLA - Ungulates**
Family **Cervidae**
- ● *Alces alces*, moose
- ● *Rangifer tarandus*, caribou

Family **Bovidae**
- ○ *Bison bison*, American bison (*introduced*)
- ● *Oreamnos americanus*, mountain goat
- ● *Ovis dalli*, Dall's sheep

**RODENTIA - Rodents**
Family **Sciuridae**
- ○ *Glaucomys sabrinus*, northern flying squirrel
- ● *Marmota caligata*, hoary marmot
- ● *Spermophilus parryii*, arctic ground squirrel
- ● *Tamiasciurus hudsonicus*, red squirrel

Family **Castoridae**
- ○ *Castor canadensis*, American beaver

Family **Dipodidae**
- ○ *Zapus hudsonius*, meadow jumping mouse

Family **Muridae**
- ● *Clethrionomys rutilus*, northern red-backed vole
- ● *Lemmus trimucronatus*, brown lemming
- ● *Microtus longicaudus*, long-tailed vole
- ● *M. miurus*, singing vole
- ● *M. oeconomus*, tundra vole
- ● *Microtus pennsylvanicus*, meadow vole
- ○ *M. xanthognathus*, taiga vole
- ○ *Ondatra zibethicus*, muskrat
- ● *Synaptomys borealis*, northern bog lemming

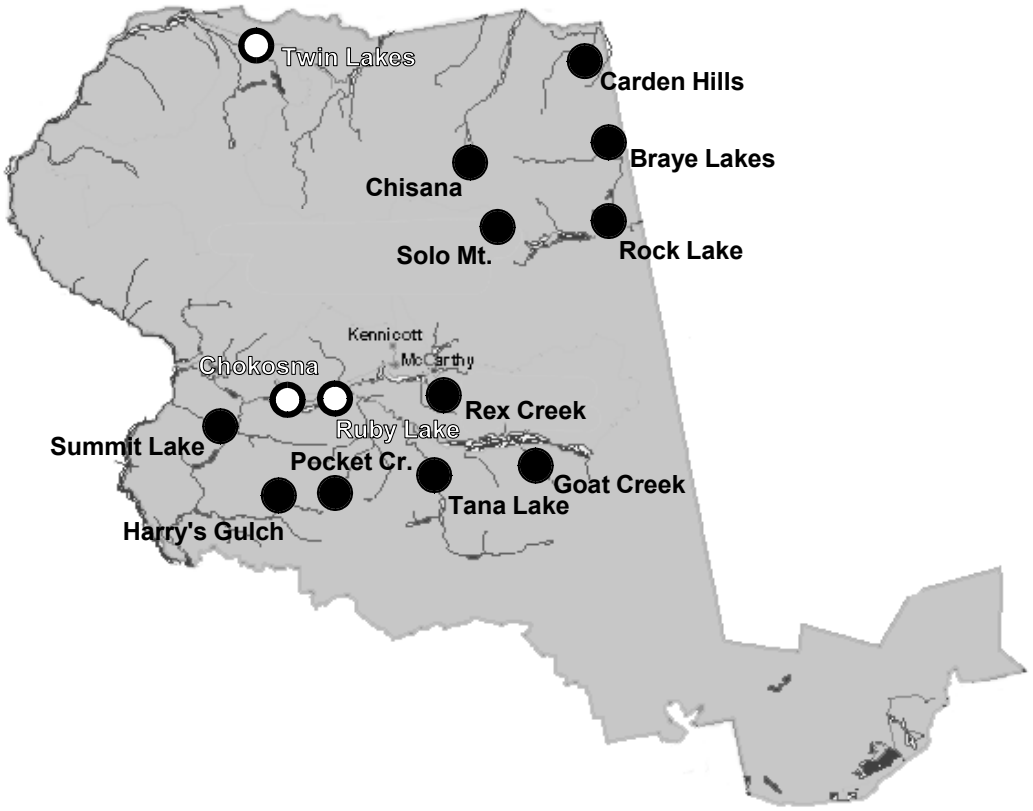
Family **Erethizontidae**
- ● *Erethizon dorsatum*, North American porcupine

**LAGOMORPHA - Pikas & Hares**
Family **Ochotonidae**
- ● *Ochotona collaris*, collared pika

Family **Leporidae**
- ● *Lepus americanus*, snowshoe hare

**Table 3**. Number of small mammals and trapping effort in vegetation types (Levels I-III of Viereck et al., 1992) sampled at 14 general localities in Wrangell-St. Elias NP&P, Alaska, in July and August, 2001 and August 2002.

| | LEVEL I | FOREST | | | | | | | | | SCRUB | | | | | | | | | | HERBACEOUS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | NEEDLE-LEAF | | | BROAD-LEAF | | | MIXED | | | DWARF TREE | | | TALL | | LOW | | DWARF | | | GRAM-INOID | | | FORB | | | BRY-OID | | AQUATIC | | |
| | III | CLOSED | OPEN | WOODLAND | CLOSED | OPEN | WOODLAND | CLOSED | OPEN | WOODLAND | CLOSED | OPEN | WOODLAND | CLOSED | OPEN | CLOSED | OPEN | Dryas | Ericaceous | Willow | DRY | MESIC | WET | DRY | MESIC | WET | Mosses | Lichens | Freshwater | Brackish water | Marine |
| MAMMAL SPECIES | **INSECTIVORA - Shrews** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | *Sorex cinereus*, cinereus shrew | | | 6 | | | | | | | | 2 | | 1 | 18 | 2 | 26 | | | | 1 | 1 | 3 | 2 | 2 | | 3 | | | | |
| | *S. monticolus*, montane shrew | 1 | | | | | | | | | | | | 1 | 1 | 8 | 18 | | | 4 | 12 | 24 | 8 | 2 | 1 | | 5 | | | | |
| | *S. palustris*, water shrew | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| | *S. tundrensis*, tundra shrew | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | |
| | *S. yukonicus*, tiny shrew | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **RODENTIA – Rodents** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | *Clethrionomys rutilus*, N. red-back. vole | 9 | 27 | 49 | 9 | | | 21 | | | | 16 | 8 | 9 | 92 | 8 | 14 | | | 12 | 9 | 4 | 5 | 2 | 1 | | | 12 | | | |
| | *Lemmus trimucronatus*, brown lemming | | | 1 | | | | | | | | | 1 | | 5 | | 1 | | | | | | | | 1 | | | | | |
| | *Microtus longicaudus*, long-tailed vole | | | 1 | | | | | | | | | | | 3 | | 7 | | | | | 1 | | | | | 1 | | | | |
| | *M. miurus*, singing vole | 2 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| | *M. oeconomus*, tundra vole | | 45 | 19 | | | | | | | | 2 | 12 | 11 | 45 | 4 | 21 | | | 2 | 5 | 8 | 7 | 3 | 2 | | 1 | | | | |
| | *M. pennsylvanicus*, meadow vole | | 1 | 2 | | | | | | | | | 6 | | 168 | 1 | | | | | | | 28 | | | | | | | | |
| | *Synaptomys borealis*, N. bog lemming | | | 9 | | | | | | | | | | | 28 | | 4 | | | 2 | 2 | | 5 | | | | 1 | | | | |
| | *Spermophilus parryii*, A. ground squirrel | | | | | | | | | | | | | | 1 | 3 | 5 | | | 2 | 1 | 1 | | 6 | 2 | | | | | | |
| | *Marmota caligata*, hoary marmot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | *Tamiasciurus hudsonicus*, red squirrel | 2 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **LAGOMORPHA – Pika & Hare** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | *Ochotona collaris*, collared pika | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | 6 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **TRAP NIGHTS** | 171 | 153 | 656 | 90 | | | 58 | | | | 50 | 90 | 110 | 949 | 386 | 1324 | | | 603 | 682 | 1563 | 407 | 643 | 431 | | 789 | 557 | | | |




**LEGEND**:
2001:

- Braye Lakes (62° 01'N, 141° 07'W): 24-28 July 2001
- Carden Hills (62° 18'N, 141° 10'W): 20-24 July 2001
- Chisana (62° 03'N, 142° 02'W): 17-20 July 2001
- Goat Creek (61° 00'N, 142° 02'W): 6-10 August 2001
- Harry's Gulch (61° 04'N, 143° 54'W): 2-6 August 2001
- Pocket Creek (61° 04'N, 143° 22'W): 29 July-2 August 2001
- Rex Creek (61° 18'N, 142° 31'W): 29 July-2 August 2001
- Rock Lake (61° 47'N, 141° 12'W): 20-24 July 2001
- Solo Mountain (61° 50'N, 141° 50'W): 24-28 July 2001
- Summit Lake (61° 19'N, 144° 14'W): 6-10 August 2001
- Tana Lake (61° 00'N, 142° 45'W): 2-6 August 2001

2002:

- Chokosna Lake (61° 27'N, 143° 47'W): 3-5 August 2002
- Ruby Lake (61° 22'N, 143° 26'W): 5-6 August 2002
- Twin Lakes (62° 32'N, 143° 15'W): 6-9 August 2002

**Figure 1.** General localities in Wrangell-St. Elias NP&P, Alaska, sampled for small mammals in 2001 (closed circle) and 2002 (open circle).

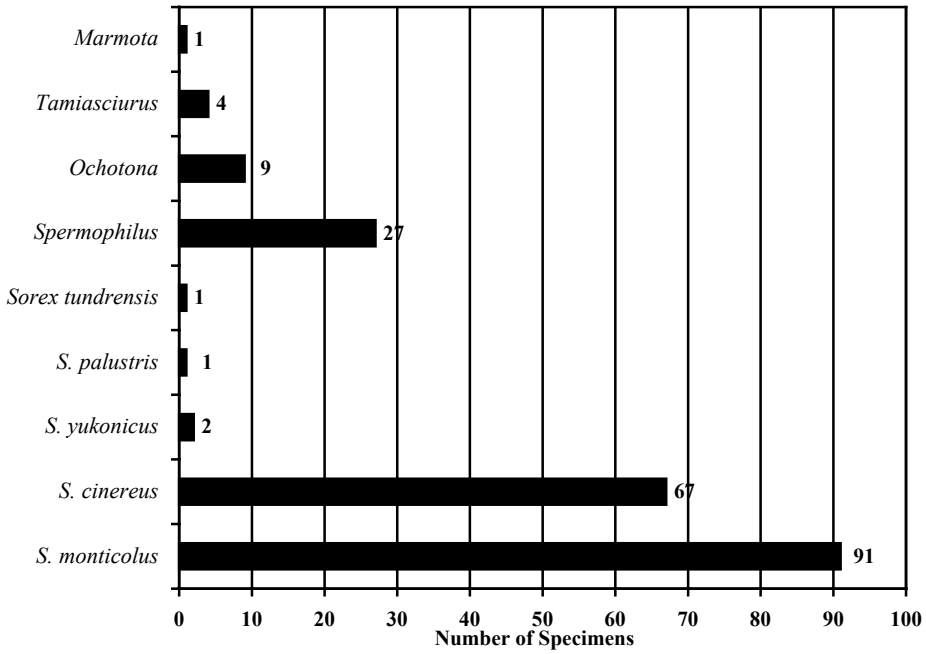



**Figure 2a**. Total number of shrew, squirrel, and pika specimens sampled in Wrangell-St. Elias NP&P, Alaska, in July and August, 2001 and 2002.

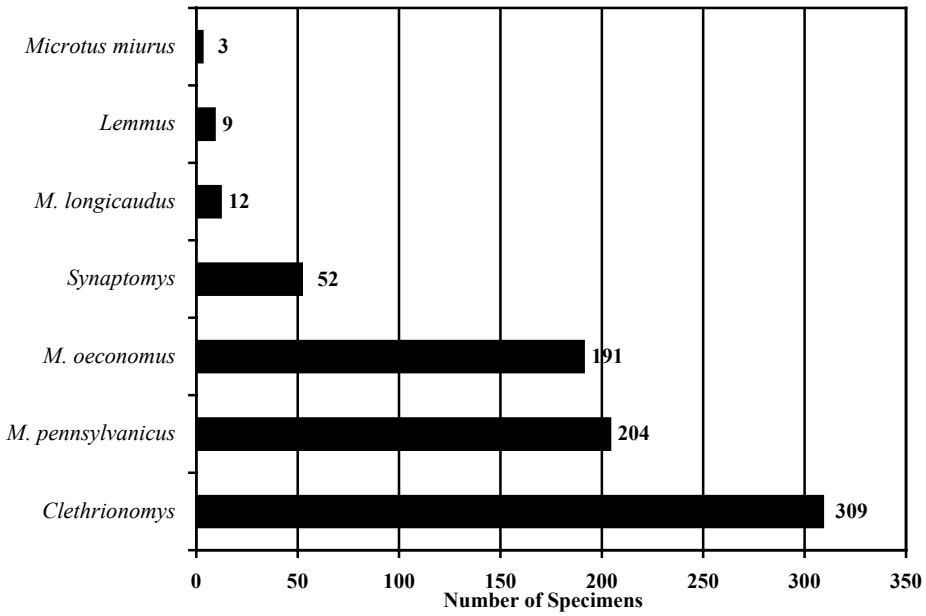



**Figure 2b**. Total number of vole and lemming specimens sampled in Wrangell-St. Elias NP&P, Alaska, in July and August, 2001 and 2002.

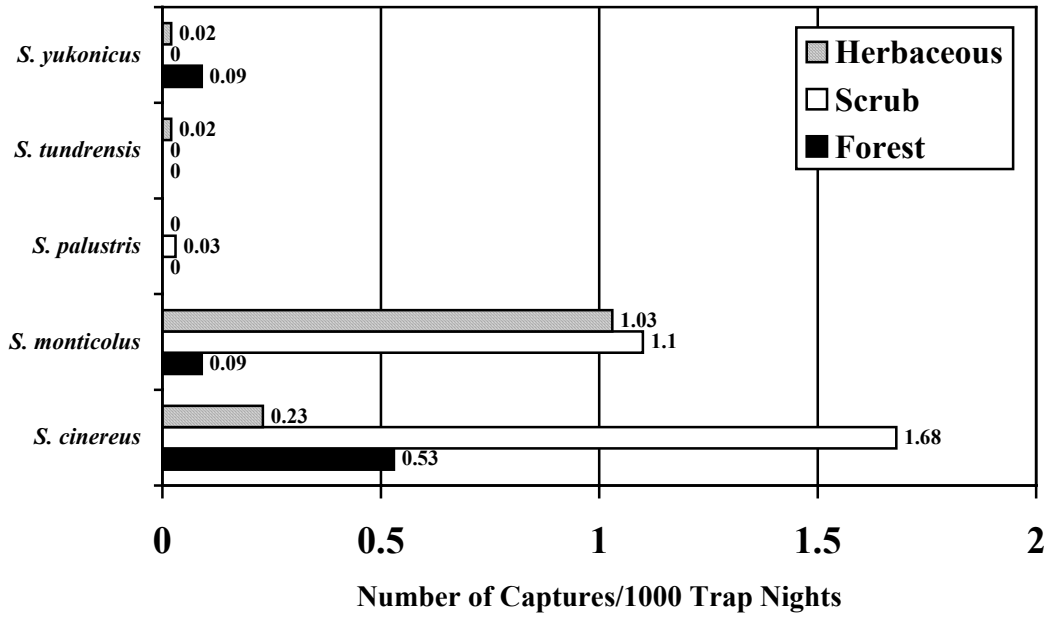



**Figure 3a**. Relative abundance (specimens/100 trap nights) of shrews in major vegetation types, Wrangell-St. Elias NP&P, July-August 2001 and 2002.

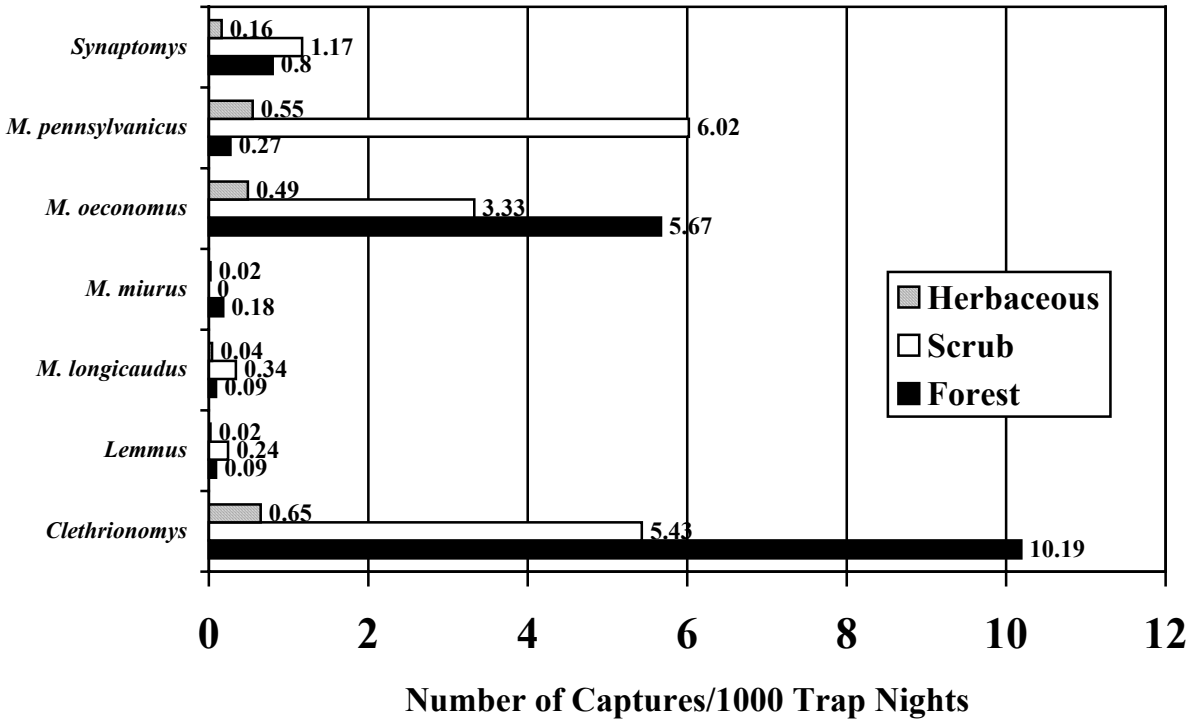



**Figure 3b**. Relative abundance (specimens/100 trap nights) of murid rodents in major vegetation types, Wrangell-St. Elias NP&P, July-August 2001 and 2002.

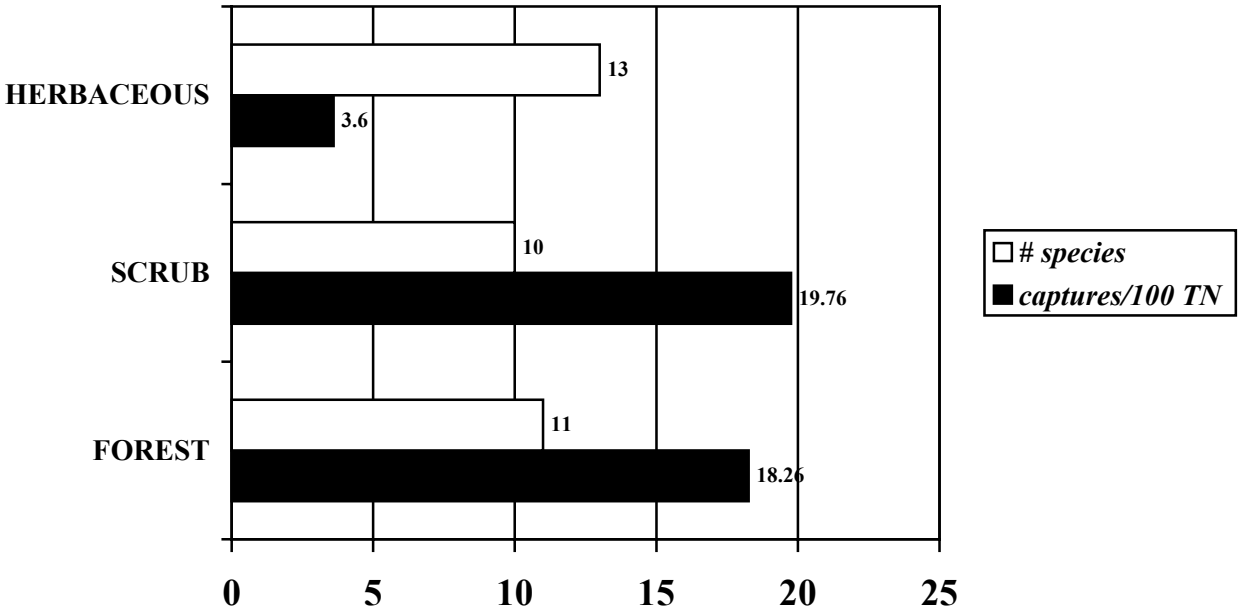



**Figure 4**. Species richness and relative abundance of small mammals in 3 major vegetation types, Wrangell-St. Elias NP&P, Alaska, 2000-2001.

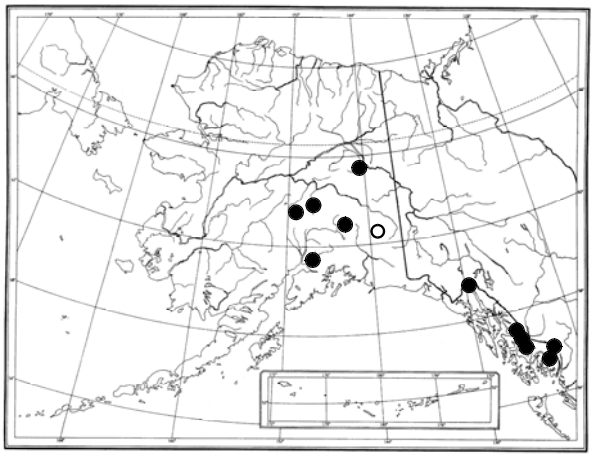


**Figure 5**. Specimen records of water shrew (*Sorex palustris*) in Alaska (open circle = new record from this study.

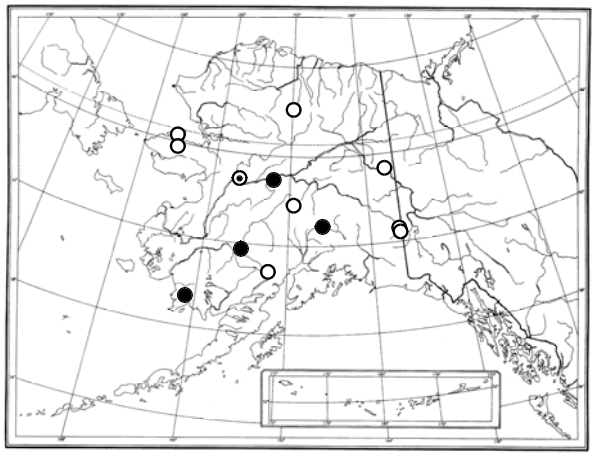


**Figure 6**. Specimen records of tiny shrew (*Sorex yukonicus*) (open circle = new NPS records; dotted open circle = type locality).

# Appendix

## SPECIFIC COLLECTION AND PRESERVATION PROTOCOLS

**SHREWS**

General: Parasites, particularly the minuscule tapeworms characteristic of shrews, decompose rapidly.

Consequently, it is necessary to make special provisions for anticipated collections of insectivores. Live traps or pitfalls should be used, and should be checked at a minimum every 3 hours. This sampling schedule is necessary as tapeworms in shrews decompose starting about 2-3 hours following death of the host. **Thus, traps must be checked frequently and any shrews collected need to be dissected immediately**. Please note in field notes how fresh the shrew was at the time of dissection.

Intestinal tracts: materials must be as fresh as possible, as decomposition of parasite specimens in shrews is exceptionally rapid and the tapeworms are very tiny and delicate. Dissect the stomach and entire small intestine from the body, leave it intact. If the specimen is fresh and/or from a mature shrew, place it in a 1.8 mL nunc tube, or appropriate size (white caplet) and freeze in LN2. If the specimen isn't fresh or as space runs out the entire intact intestine can be preserved in $^{700}$/o ethanol, use a 20m1 scintillation vial. If ethanol is used it must be changed on the following day. **Immediate processing and preservation of intestinal tracts of shrews has the highest priority.**

**OTHER MAMMALS**

General: In water, using a petri dish of appropriate size, first uncoil the intestine, separate the small intestine, large intestine, and caecum, process separately. Record the total number (and sex ratio if possible) of each parasite type from each organ separately in the comments section of the AF sheets.

Small intestine: In water, remove the mesenteries, straighten, and open lengthwise starting in the anterior by carefully sliding blunt tipped iris scissors to cut open and expose the lumen. Alternatively, dissecting can be approached from the posterior end, allowing the dissector to encounter the posterior end of the worm first. Be careful not to cut tapeworms; remove intact tapes to a separate dish in water to relax. "Wash" (agitate) the intestine sections in the petri dish for the detached scolices and small nematodes. Record the location of the worm in the small intestine (first, second, or third part). Look carefully for any scolices if detached: this will be accomplished by using a dissecting scope or magnifying loop; pour extra water carefully away before this but do not lose the small worms.

Caecum: Nematodes or small flukes may be present in the caecum. Often trematodes (reddish--brownish in color) in the caecum of *Microtus* are covered with "mud" and are difficult to see and some nematodes are relatively small and obscure. It may be useful, therefore, to run material through a small sieve to first discard some fine particulates. *Dicrostonyx* has a nematode that is spiraled around the villi in the caecum wall.

Large Intestine: Process only if sufficient time is available; there will be little of importance here in arvicolines. Use the same techniques as with the caecum.

## ALL MAMMALS

Stomach: Open in a dish of water, examine for nematodes. These are usually associated with the lining of the stomach and are on the outside of the stomach contents.

Lungs: First remove the left half of the lungs for hanta virus (see later) and freeze: be careful and use sterilized forceps only (70% ethanol and cigarette lighter). Label nunc "Hanta". Visually examine rest of lungs for nematodes. These may appear as small tan lesions on the surface and extending deeper into the lung tissue. If nematodes are present freeze ½ lung in nunc tube (white caplet) and label Lung/Nematode. One rare genus, *Angiostrongylus,* can be found in the big arteries of lungs.

Bladder- Open bladder in petri dish and examine contents under dissecting microscope.

Other Organs/Tissues- Basically parasites can occur in almost any organ- generally they are most abundant in the GI tract, but other organs including the liver (and gall bladder), etc., and the body cavity, should be examined (see Gardner protocols). Liver cysts or other Taeiid larvae loose in the coelom or thoracic cavity should be preserved in 70% ethanol.

**Important- remember that all dishes, and dissecting instruments have to be completely clean and dry between animals. Wash and then rinse with ethanol. Tips of probes, scissors and micro-forceps can also be passed briefly through a flame after dipping in ethanol.**

## PARASITE HANDLING AND PRESERVATION

Cestodes (All mammalian taxa excluding shrews): Following collection from the small intestine, each specimen should be held in filtered water for an extended period (minimum 2 hours, preferably more). This allows the tapeworm to fully relax, which is necessary to examine the internal structure of the proglottids. **Following relaxation and death in water, all strobilate adult tapeworms will be preserved in** 70% **ethanol**. Preservation should be done flat for large tapes including *Andrya* and some *Hymenolepis* in rodents; this is done by leaving the cestodes in a dish of ethanol overnight, and transferring the specimen to a vial the following day. Use the appropriate size vial for the specimen so there is sufficient preservative (a ratio of about 5:1 in volume for preservative relative to the specimen is maintained). The preservative should be changed once after 24 hours. Some tapeworms in *Microtus* are quite large (up to 20 cm), so be certain to use the proper size vial- one that is large enough for the worm and a sufficient amount of ethanol. Note the location of cestode in the intestine and record in the AF book. If problems with vial size, a big tape can cut in two parts and preserved in two vials. Use one number with a and b, mark on the notes.

Digenia (Flukes): Flukes can be relaxed in filtered water, which often allows specimens to expel eggs that might otherwise obscure some organs. Preserve flukes in 70% ethanol; (or alternatively freeze in LN2 (white caplet)); if there are large numbers do both. Keep parasites from different organ systems separate.

Nematodes: Nematodes should not be held in water for extended periods of time, as osmotic pressure will eventually cause the specimen to burst. Specimens should be washed in water or saline and then preserved in 70% ethanol or frozen in LN2 (white caplet); if there are large numbers do both. Keep parasites from different organ systems separate.

Enteric Coccidians (see protocols in Gardner): Fecal samples to isolate coccidia should be taken from all species of mammals. Collect a few pellets from the rectum or a scraping from the caecum/large intestine, crush the pellets and put in potassium dichromate (2% solution). **Important:** 1) do not overfill the vial, oxygen is necessary for survival of the coccida, and 2) the specimens should not be frozen.

Blood parasites

**Spleen Smears:** Divide the spleen in half. Prepare a spleen smear (see Gardner); air dry and then fix with 100% methanol; store in a dry container, avoid changes in temperatures, moisture and condensation. The focus for this work is *Clethrionomys, Microtus* and *Peromyscus* and shrews; any lagomorphs; and marmots. Do a smear from snap- trapped animals. Freeze 1/2 separately in Alsever's solution and include the other half with the heart. Indicate on AF page if the spleen is enlarged.

**Brain tissue, *Marmota*:** Collect some brain tissue for freezing (lavender caplet).

**Protocols for Ectoparasites (see** protocols in Gardner): Open collection bag and place in sealed jar with chloroformed cotton balls for 5 minutes or more. Loosely stroke pelage of animal into the bag, then examine more closely for ticks, fleas, and mites. Wash collection bag with 70% ethanol, then cut corner of bag and let contents drain into a small vial. Add ecto juice to fill. Comment in the AF book the condition of the animal (as to whether or not the animal was wet vs. dry). **Do not re-use collection bags!!**

**Protocols for Hanta Virus:** Focus on the following rodents: *Clethrionomys, Lemmus, Dicrostonyx* and *Microtus.* Be sterile. The rodent's left lobes of lungs are frozen in a single tube; do not include with other organs; mark tube as Hanta, use no caplet (these will go with Dr. Henttonen for later screening).

**Tissue-Cyst Forming Coccidia:** Typically these will be found in old arvicolines. *Sarcocystis* may be present on the peritoneum and in the musculature of the hind legs as whitish thread-like structures; if observed in the peritoneum, preserve some hind-leg musculature in 70% ethanol. *Frenkelia* may be present in the brain; cysts are easily seen as whitish spots (0.5-1.0 mm) on the surface of the brain. Do not collect from specimens with intact skulls destined for the Museum. In animals with broken skulls: first remove the upper part of the skull by cutting the bone between the eyes; remove skin from the eyes backwards; cut the skull (but not the brain) starting from the eyes along the sides, and then lift the top from the anterior part exposing the brain. If present, cysts (whitish spots) will be visible; remove brain with forceps; slice into 2 or 3 parts; preserve in 70% ethanol. Remember to save the dentition from these animals.

# HOW TO FILL AND LABEL CRYOTUBES

In the Alaska Frozen Tissue Collection, tissue samples are stored in 1.8 milliliter plastic cryotubes. These should be **labeled with an ultrafine Nalgene lab marker no. 6310-0010** or a **ultra fine "Sharpie" permanent marker prior to cooling.** If the tubes are not labeled before cooling, it will be necessary to rewarm the tubes in order to write on them.

The standard tissues saved on birds and mammals are heart, kidney, liver, and spleen. For small species entire organs are often stored in one tube. For larger animals, only a subsample of the organ will fit in a tube. In some cases, muscle, skin, or blood may be the only tissues collected.

Specimens should be kept clean, but are not expected to be sterile. It is especially necessary to **avoid cross contamination between individuals.** Tiny amounts of DNA from another specimen can be amplified and corrupt results. Therefore, **instruments and work surfaces should be cleaned after each individual is sampled. We use a ten percent solution of chlorine bleach** in **water to clean oft instruments. The instruments are wiped dry, then rinsed in clean water, and then wiped until dry with clean tissue paper.** Bleach destroys DNA and is an excellent disinfectant. Alcohol preserves DNA and therefore should not be used to clean instruments.

**COMMON PROBLEMS**

**Over** filling: Tubes that contain too much tissue will split when the tissue freezes and expands. Observe the fill line (approximately 2/3 full) when preparing large samples.

**Loose caps**: Caps may come loose and the samples may come out of the tubes. Please tighten caps firmly. This is particularly important when tubes are traveling in Dewar flasks of liquid nitrogen.

**Inadequate labeling**: Sloppy handwriting and faulty writing implements are major problems. **Write the AF number on the tube at least twice, and on the cap once.** Don't **try** to write on greasy, wet, or frozen tubes. Writing may be worn off of tubes if they are subjected to a lot of agitation while traveling in liquid nitrogen. This problem occurs with bags used to presample the tissues as well. Bags should be clearly labeled and if possible, a label should be included in the bag with the sample. Be sure to avoid cross contamination among bagged tissues and try to collect samples large enough so that we can obtain a cleanly trimmed final sample.

AF 46286

# ALASKA FROZEN TISSUE COLLECTION
## University of Alaska Museum

Collector: Nikolai Dokuchaev

Preparator: Amy M Runck Field #:

Species: Lemmus trimucronatus Sex: (M) F ?

Country/State: USA/AK Quad: Bendeleben

District (e.g. island, county, Nat'l Park): Bering Land Bridge

Specific locality: Kruzitrin Lake

Latitude: 65°23.363'N Longitude: 163°15.868'W Authority: GPS

Date of death: 28 July preparation:

**Nature of voucher** (Circle one or more): (skin) skull skeleton

fluid-preserved whole frozen tissues only other

| **Preserved tissue** | #tubes | pres | **Preserved tissue** | #tubes | pres |
|---|---|---|---|---|---|
| heart | | | blood | | |
| kidney + liver | 1 | Fz | karyotype | | |
| heart & kidney | | | ectoparasites | | |
| H, K, lung, spleen | 1 | Fz | nematode | | |
| liver | | | cestode | | |
| spleen | | | coccidia | 1 | cocc |
| lung | | | other(Telford) | 1 | Fz |
| muscle | | | other( ) | | |

**Condition of tissues** (Circle one): (poor) 1 2 3 4 (5) (excellent)

**Relationship**: of #

**Repro condition**: T=7x4

**Measurements** (total-tail-hindfoot-efn-weight): X

**Remarks**:

negative for endoparasites

Museum use: **Collection**: Mamm UAM# Accession # 2001.040

PERMANENT ARCHIVAL RECORD - Please use permanent ink and return to University of Alaska Museum, Fairbanks, AK 99775-6960